this system will provide the competitive benefits to the public that the Commission is striving to achieve in this rulemaking.

2. New Little LEO System B

Leo One USA proposes that this system use the downlink spectrum that was proposed by the Commission for Little LEO System 2. For the uplink it is proposed that the spectrum available for narrowband operation be used equally by System A and System B.

Specifically for the downlink, it is proposed the NOAA LRPT bands (137.025-137.175 MHz and 137.825-138.0 MHz) be used exclusively on a 100% availability basis until the first European METOP-1 MetSat is launched in 2002. This band would be time-shared on a non-interference basis thereafter to all MetSats by using the opposite LRPT band when the Little LEO horizon coverage overlaps the MetSat footprint. NOAA will begin to launch its new satellites using the LPRT bands beginning in 2003. Once two MetSats begin using the LRPT band and 100 percent availability cannot be assured, it is proposed that the TIP channel (137.333-137.367 MHz and 137.753-137.787 MHz) sharing with NOAA begin. This will ensure that the availability remains close to 100 percent and near real-time services are preserved. As the older generation NOAA satellites fail or are turned off, the TIP channels will become available on an exclusive basis and 100 percent availability is again achieved.

For the uplink, the following is proposed: (i) the 149.95-150.0 MHz band segment, which is allocated for LMSS (no maritime or aeronautical use), will be time-shared with the Russian Navigation Satellite System (RNSS) as well as with land mobile radios in most countries; (ii) the 149.855-149.9 MHz band segment will be time-shared with VITA; and (iii) the 148.905-149.81 MHz band will be dynamically shared with Orbcomm and System A. This sharing will all be

TABLE 1: HHI Analysis

Potential Licensing Outcomes

1 Today's environment

Licensee	Orbcomm, Starsys & VITA each fully deploy licensed systems			VITA operates in specialized non-for-profit market			Starsys fails to launch its system			Neither VITA or Starsys participate in the market		
	Capacity	Market Share	HHI	Capacity	Market Share	HHI	Capacity	Market Share	HHI	Capacity	Market Share	HHI
Orbcomm	1	76.51%	5854	1	80.00%	6400	1	94.61%	8951	1	100.00%	10000
Starsys	0.25	19.13%	366	0.25	20.00%	400	0	0.00%	0		0.00%	0
VITA	0.057	4.36%	19	0	0.00%	0	0.057	5.39%	29		0.00%	0
	1.31		6239	1.25		6800	1.06		8980	1.00		10000
Market Concentration			6239	Market Concentration		6800	Market Concentration		8980	Market Concentration		10000

2 No new licensing, Orbcomm 2nd round ammendment is accepted.

Licensee	Capacity	Market Share	HHI	Capacity	Market Share	HHI	Capacity	Market Share	HHI	Capacity	Market Share	HHI
Orbcomm	1.16	79.07%	6253	1.16	82.27%	6768	1.16	95.32%	9085	1.16	100.00%	10000
Starsys	0.25	17.04%	290	0.25	17.73%	314	0	0.00%	0		0.00%	0
VITA	0.057	3.89%	15	0	0.00%	0	0.057	4.68%	22		0.00%	0
	1.47		6558	1.41		7083	1.22		9107	1.16		10000
Market Concentration			6558	Market Concentration		7083	Market Concentration		9107	Market Concentration		10000

3 Three additional licenses awarded as proposed in Systems 1, 2, & 3 by the NPRM.

Licensee	Capacity	Market Share	HHI	Capacity	Market Share	HHI	Capacity	Market Share	HHI	Capacity	Market Share	HHI
Orbcomm	1	42.30%	1789	1	43.35%	1879	1	47.30%	2238	1	48.61%	2363
Starsys	0.25	10.58%	112	0.25	10.84%	117		0.00%	0		0.00%	0
VITA	0.057	2.41%	6		0.00%	0	0.057	2.70%	7		0.00%	0
System 1	0.057	2.41%	6	0.057	2.47%	6	0.057	2.70%	7	0.057	2.77%	8
System 2	0.84	35.53%	1263	0.84	36.41%	1326	0.84	39.74%	1579	0.84	40.84%	1668
System 3	0.16	6.77%	46	0.16	6.94%	48	0.16	7.57%	57	0.16	7.78%	61
	2.36		3175	2.31		3328	2.11		3831	2.06		4039
Market Concentration			3175	Market Concentration		3328	Market Concentration		3831	Market Concentration		4039

4 Two additional licenses awarded as proposed in System A & B by Leo One USA.

Licensee	Capacity	Market Share	HHI	Capacity	Market Share	HHI	Capacity	Market Share	HHI	Capacity	Market Share	HHI
Orbcomm	1	31.98%	1023	1	32.57%	1061	1	34.76%	1208	1	35.46%	1257
Starsys	0.25	7.99%	64	0.25	8.14%	66		0.00%	0		0.00%	0
VITA	0.057	1.82%	3		0.00%	0	0.057	1.98%	4		0.00%	0
System A	0.9	28.76%	828	0.9	29.32%	859	0.9	31.28%	979	0.9	31.91%	1019
System B	0.92	29.42%	866	0.92	29.97%	898	0.92	31.98%	1023	0.92	32.62%	1064
	3.13		2784	3.07		2885	2.88		3213	2.82		3340
Market Concentration			2784	Market Concentration		2885	Market Concentration		3213	Market Concentration		3340

accomplished using dynamic channel assignment techniques. The total downlink capacity of this system is 1069 Mbits per day or 92% of Orbcomm, and the total uplink capacity would be 1135 Mbits per day or 98% of Orbcomm. This would create a system with 92% of Orbcomm's capacity that would be able to provide near continuously available[51] services from land, sea and air. As discussed in greater detail in Appendix F, this system will also be capable of providing near real-time services.

D. Competitive Analyses of Little LEO System A and Little LEO System B

A comparative analysis of market structures reveals a significant reduction in market concentration if System A and System B are implemented instead of the three systems proposed in the Notice. Table 1 presents capacity, market share and the resulting HHI level (i) under the licensing regime proposed by the Commission, (ii) the new licensing regime proposed herein by Leo One USA, and (iii) if all the available spectrum were assigned to Orbcomm. As shown, Orbcomm has the largest capacity and greatest potential market share. Presuming that VITA operates on a specialized not-for-profit basis, it is clear that today's NVNG MSS supply is highly concentrated. Orbcomm has an 80% share and Starsys has a 20% share, which translates into an HHI level of 6800. This would be deemed a market structure conducive to an exercise of market power under the *Guidelines*. If Orbcomm's second round amendment is accepted, this would result in a HHI of 7083. In the Notice the Commission proposes to introduce three new NVNG MSS. These three systems would reduce the HHI from today's 6800 to 3328. This would result in a highly concentrated market

51 *Id.*

under the *Guidelines*. If the Commission were to adopt the proposal of Leo One USA to create Little LEO System A and Little LEO System B, the HHI would be reduced to 2885.[52]

In contrasting the Commission's proposal for Little LEO Systems 1, 2 and 3 and Leo One USA's proposal for Little LEO System A and Little LEO System B, four points stand out. First, the Leo One USA proposal results in a much more efficient use of the available spectrum. If the Commission were to implement the Leo One USA proposal the total capacity would be 3.13 "Orbcomm equivalent units." This is compared to 2.36 units under the proposal in the Notice. As compared with the current first round assignment scheme, there would be a 139% increase in capacity under the Leo One USA proposal, as opposed to an 80% increase in total capacity under the proposal in the Notice. As in any market, a larger total capacity (holding constant the distribution of that total capacity among suppliers, as measured, for example, by the HHI) can be expected to result in lower costs (either financial costs or opportunity costs or both) to providers, greater output, lower prices, and larger gains to consumers.

Second, the comparative advantage of the Leo One USA proposal increases dramatically if VITA operates in specialized not-for-profit markets and/or GE Starsys fails to launch its system. If neither VITA nor GE Starsys participate in the commercial market, the advantage of the Leo One USA proposal increases from a 59% increase in capacity to a 76% increase in capacity.

Third, under the Leo One proposal, (greater) capacity is allocated so as to produce a more competitive market structure. Although the number of suppliers is smaller (five rather than six) than in the proposal in the Notice, capacity is more evenly distributed over those five suppliers. This

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[52] Thus, the HHI for the Leo One USA spectrum allocation proposal is 443 points lower than the HHI for the proposal in the Notice. The *Guidelines* define an HHI change of 100 points or more to be significant for purposes of a competitive analysis.

more equal distribution more than offsets the effect on the HHI of a smaller number of suppliers, resulting in a significantly lower HHI under the Leo One USA proposal than under the proposal in the Notice.

Fourth, as was the case for total capacity, the effect on the competitiveness of the market (as measured by the HHI) from excluding incumbent suppliers from the allocation (or auction) increases with the possibility that VITA and/or GE Starsys will not be effective competitors in the relevant markets. If VITA operates in specialized not-for-profit markets and GE Starsys fails to launch, the percentage decrease in the HHI achieved by excluding incumbent suppliers from the allocation (or auction) -- a proxy for the percentage decrease in prices -- goes from a 49% decrease to a 60% decrease under the proposal in the Notice and from a 55% decrease to 67% decrease under the Leo One USA proposal.[53]

As these calculations show, it is important not simply to count the number of suppliers in a market in determining the likely competitiveness of the market or the welfare of consumers. The effect on the prices paid by consumers from a larger number of suppliers can be swamped by the effects of larger total capacity or by the effects of a more even distribution of that capacity or -- as in this case -- both.

VI. SPECTRUM ALLOCATED AT WRC-95 AND WRC-97 SHOULD BE MADE AVAILABLE TO PENDING QUALIFIED APPLICANTS BEFORE EXISTING LICENSEES ARE ELIGIBLE TO USE THE SPECTRUM

The fundamental policy of the Commission for the NVNG MSS should be to introduce effective competition and new and innovative services for the benefit of the public. In order to fulfill

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[53] *See* Appendix A for a more detailed explanation.

this goal, the Commission should establish a spectrum priority. Specifically, the Commission should assign WRC-95 and WRC-97 spectrum or any other future allocations so that the new NVNG MSS systems can effectively meet the business requirements of their pending applications and provide a competitive marketplace. Once these applicants' requirements are satisfied, the Commission should evaluate how any remaining spectrum can best be used. Specifically, the Commission will need to determine whether the spectrum would have greater marginal utility if assigned to existing licensees or to new entrants. In this regard, Leo One USA believes existing licensees should not be foreclosed from obtaining access to additional spectrum in the future. However, existing licensees should be deemed eligible to obtain additional allocations after the markets for NVNG MSS services are determined to be competitive. Once the markets are competitive, a case might be made that the existing licensees could make more effective use of the spectrum than a new entrant.

VII. LEO ONE USA SUPPORTS THE COMMISSION'S PROPOSAL TO IMPOSE THE DOMSAT FINANCIAL QUALIFICATION TEST

A. The Commission Should Require Each NVNG MSS Applicant to Demonstrate the Financial Qualifications to Construct, Launch and Operate for One Year Its Entire Proposed Satellite System

Leo One USA supports the Commission's proposal to use the financial qualification tests for the domestic fixed-satellite service to ensure that unqualified NVNG MSS applicants do not warehouse spectrum. The Commission has correctly concluded that "in cases where there are more applicants than the spectrum can accommodate, a grant to an under-financed space station applicant may preclude a capitalized applicant from implementing its system, and delay service to the

public."[54] Leo One USA agrees that application of the Commission's Domsat financial qualifications requirement is appropriate in those cases.

As the Commission is well aware, there is a very limited amount of spectrum available to the second NVNG MSS processing round. Here, where there is not sufficient spectrum to accommodate all the applicant's requirements, it is critical that under-financed companies not receive licenses. The Commission's extensive experience in this area has shown that licensees without sufficient available resources spend a significant amount of time attempting to raise the necessary financing for their systems and that those attempts often end unsuccessfully. An undercapitalized applicant may thus preclude a fully capitalized applicant from implementing its plans, thereby denying competitive services to the public.

The Domsat standard that the Commission proposes to apply to the NVNG MSS is the only suitable financial qualification test to ensure that unqualified applicants do not thwart competition. The Commission has over ten years of experience with this test. Given that not enough spectrum is available to accommodate all second round applicants, any lesser standard will not suffice.

The Commission should clarify, however, the exact terms of the standard to be adopted. Leo One USA endorses the Domsat standard codified at Section 25.140(d) of the Commission's Rules.[55] This standard, as detailed in Section 25.140(d), requires applicants to provide sufficient evidence of current assets and an irrevocable commitment of those assets to ensure financing for these systems. In its Domsat proceeding, the Commission defined "current assets" as "cash plus other assets reasonably expected to be realized in cash or sold to customers during a normal operating cycle of

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54 *Notice* at ¶ 39.

55 47 C.F.R. § 25.140(d).

a business."[56] Leo One USA encourages the Commission, as it did in the Big LEO proceeding, to include in its financial commitment rules a requirement that all applicants, including those relying on internal assets, provide evidence of a management commitment to the project.[57]

B. The Commission Should Immediately Apply its Current Financial Qualification Standards

As Leo One USA has repeatedly stated in the second NVNG MSS processing round, the Commission should apply its current financial qualification test to the pending second round applications. Application of the current test to the pending applications is imperative to preserve the integrity of the Commission's process. Participants in the second round submitted their applications in November 1994 with the expectation that the Commission would apply the NVNG MSS rules in existence at that time. Two years later, the Commission has not yet processed those applications. Leo One USA continues to believe that processing the applications under the current rules has the potential to reduce the conflicts among applicants and to facilitate settlement. If mutual exclusivity exists after application of the existing NVNG MSS rules, Leo One USA endorses the immediate use of the more stringent Domsat financial qualification requirement.

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56 Leo One USA also encourages the Commission to consider whether additional rules are necessary to ensure that applicants actually demonstrate liquid assets that could be used to fund construction, launch and operation of the proposed systems. Current assets based on intracorporate transactions or valuations not based on marketplace realities could be used to artificially inflate an applicant's current assets or costs from a pure accounting perspective. Those artificial figures could mask a lack of actual cash or other liquid assets to be used to finance system construction, launch and operation. Leo One USA would support Commission efforts to ensure this abuse of the financial qualification test is prohibited.

57 *See* 47 C.F.R. § 25.143(b)(3). Appendix C contains proposed amended Rule 25.142(a)(4) which mirrors the Big LEO financial qualification requirements.

VIII. LEO ONE USA SUPPORTS THE COMMISSION'S DECISION NOT TO MANDATE A VIRTUAL CONSTELLATION OR SIMILAR FORCED SETTLEMENTS

Leo One USA supports the Commission's determination that the public interest would not be served by mandating participation in a "virtual constellation" or similar consortia.[58] Although the virtual constellation approach would provide an expeditious means to dispose of the pending second round NVNG MSS applications, it would not fulfill the Commission's stated goal to "enhance competition [that] will lead to lower prices and increased service options for customers."[59] Implementation of the virtual constellation will merely eleminate the opportunity for the introduction of new competitive NVNG MSS systems capable of serving all Little LEO markets. This result would not be in the public interest.

Under FACS' virtual constellation concept, the Commission would authorize each applicant to construct and launch a limited number of satellites, each "required to carry the communications payload of the other applicants."[60] FACS offered two approaches for implementing the virtual constellation: (i) standardization of common design elements that would be incorporated into each applicant's satellites or (ii) attachment to each satellite of a "black box" containing receive, transmit and digital data handling components for each of the satellite systems in the virtual constellation. FACS proposed that an "industry committee" facilitate selection of the appropriate methodology for implementing the virtual constellation concept. A close look at the virtual constellation concept indicates it is simply another name for a forced consortium or a Commission-mandated standard for

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58 *Notice* at ¶ 44.

59 *Notice* at ¶ 2.

60 Letter from Aileen A. Pisciotta to Donald Gips dated July 18, 1996, Description of the Virtual Constellation Concept at 1.

NVNG MSS systems. For the reasons discussed below, this approach will discourage competition, distort marketplace performance, and impose barriers to the development of NVNG MSS technology.

A. The Virtual Constellation Would Not Promote Competition

Adopting a virtual constellation would undermine the Commission's goal of promoting competition for NVNG MSS services. The FACS proposal does not envision the licensing of full competitors to the existing NVNG MSS licensees. Instead, FACS seeks partial system licenses that would create numerous weak competitors. These systems, permanently dependent on their competitors for capacity, would have no flexibility to pursue independent marketing strategies, to develop innovative services or to deploy optimum technical solutions to meet market requirements. The participants in the virtual constellation would be restricted in their range of services and would be forced to compete for niche markets in the absence of the ability to directly challenge the existing first round licensees. Specifically, small systems (six satellites or less) would be restricted to a handful of Little LEO markets because these systems would have a significant number of outages greater than six hours. Few consumers would benefit from such systems, and the gain to consumer surplus from this approach would be negligible.

Leo One USA has considered several less capital-intensive scenarios to its 48-satellite system. The problem faced by systems with fewer satellites is that there are large numbers of markets which cannot be served when there are communication delays of more than a few minutes. Any company deploying a complete constellation capable of near-real-time services can provide the same services the partial system provides as an incremental business, making it virtually impossible for the partial system operator to compete. Additionally, a system with limited channel capacity cannot compete with larger systems or even small systems with more channels. The system with

more channels will be able to spread its fixed costs over more revenue producing channels. This will allow the system with more channels to keep costs lower vis-a-vis the smaller channel capacity system. Additionally, the larger system will be able to better spread its development, constructionand launch costs than a smaller capacity system. Thus, it will be more expensive on a satellite-to-satellite basis to implement a small capacity system. Given this market structure, any company licensed to implement a full constellation will have every incentive to aggregate these partial system licenses on very favorable terms, which will in turn further limit the benefits of competition to the public.

B. The Virtual Constellation Approach is Impractical

A virtual constellation presents numerous business and technical problems which render the concept infeasible. First, there is no guarantee that a future WRC would allocate spectrum to the NVNG MSS that would be available in the near term. Therefore, any company investment in a partial system would have to be based on a decision that it could competitively operate a limited-satellite system. Leo One USA does not believe that a business case can be made for such a system and will not invest in a system based on the promise of spectrum which may or may not be available in the future.

Second, it is inconceivable that a partial system with no assurance of any additional spectrum to support a full satellite constellation could justify the development costs and volume production required to create a user terminal with competitive features and costs, nor would customers invest in equipment for a system with a limited future. The cost of customer equipment is the most important factor in market penetration and profitability in every form of wireless communications business.

Third, the hope that multiple partial system licensees would consolidate into one or more viable systems is not based in reality. Issuing licenses for partial systems is tantamount to conducting a limited lottery with the hope the market will dictate the right form of consolidation. As was the case in the cellular lotteries, the consolidation phase of this process will be inefficient, untimely and result in the enrichment of speculators -- not parties with a real interest in delivering the most valuable service to the public.

Fourth, in order to permit sharing between systems, participants in the virtual constellation would be obligated to develop joint user equipment capable of communicating with all the systems. The participants would need to modify system designs to implement relatively identical spacecraft or similarly equipped spacecraft. These changes would eliminate the distinctions between systems and greatly reduce the possibility of innovation and competition among systems.

Fifth, in order for these multiple partial systems to operate in a compatible fashion it would be necessary for each licensee to disclose proprietary technical information to other licensees. This could undermine an individual licensees' competitive position in the future.

Finally, the existing licensees have no incentive to facilitate the coordination of competing satellite systems; in fact, they have a natural incentive to see the second round remain unresolved or, at a minimum, completely fragmented, so as to maintain first round licensee market dominance. Given this situation, chances for successful coordination are unlikely.

Leo One USA is also concerned that the capital markets will reject the virtual constellation approach, precluding the introduction of any new NVNG MSS competitors. It is unlikely the participants would be able to justify the development, construction and launch costs of a partial system not capable of robust competition with first round licensees without the assurance that they

will have the spectrum necessary to implement their full business plan. This problem is exacerbated by the fact that FACS provides no plan on how the participants would transition from the virtual constellation to fully independent systems. According to FACS, if additional NVNG MSS spectrum is allocated at future World Radio Conferences, the FCC could authorize partial licensees to build out complete systems. Each participant then would be free to operate its system with its own proprietary design at a different altitude and orbit from the virtual constellation. However, it must be recognized that it is likely that such systems would be authorized at new frequencies allocated by a WRC. These frequencies are likely to be different than the frequencies used for the virtual constellation.[61] This would render the virtual constellation useless and all user equipment designed for the virtual constellation obsolete. This would have a negative effect both on the customer base and the future efficient use of the spectrum. The virtual constellation would merely turn into an orphan satellite system. The capital markets will not embrace a system concept that has great potential to provide no return on the investment on such a tenuous and extended time horizon.

IX. SPECTRUM SHARING PROPOSALS

The Commission in the Notice proposes a revolutionary sharing approach be used for the NVNG MSS: the time-sharing of spectrum between incumbent and new users. Specifically, the Notice proposes that new NVNG MSS systems will time-share with the following: VITA in the 148.0 - 149.0 and 400.15 - 401 MHz bands, the NOAA MetSat system in the 137 - 138 MHz band, and the DOD Defense Meteorological System Program ("DMSP") in the 400.15 - 401 MHz band. Additionally, the Commission proposes to allow sharing of the 148.905 - 149.810 MHz band with

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61 It is entirely possible that the virtual constellation would use frequencies in the VHF band and new spectrum would be allocated in the UHF band. Use of the UHF band would require introduction of entirely new antennas for the satellite and the transceiver.

Orbcomm and the 149.95 - 150.05 MHz band with the radio navigation service. Leo One USA applauds the Commission for developing this revolutionary new concept that will facilitate the introduction of new competitive NVNG MSS services. The following is a review of the sharing schemes, the proposed sharing rules and the technical issues associated with those rules.[62]

A. Sharing with VITA in the 148.0 - 149.9 and 400.15 - 401 MHz band

The Commission proposes that a new NVNG MSS system could time-share with the currently authorized VITA NVNG MSS satellite. This should be a relatively simple matter. The newly licensed NVNG MSS system can operate in a manner that will allow VITA to operate on an interference-free basis. This can be accomplished if the new license does not transmit during the times that the VITA satellite coverage footprint overlaps that of any new NVNG MSS satellite at a 5°elevation angle[63] using the VITA frequencies. The coincidence times of coverage overlap can be readily computed and frequency selection instructions can be loaded into each satellite to span the duration of element set validity. All that is required of VITA is to provide the new licensee accurate ephemeris data on a regular basis. The actual mechanics of this time-sharing regime should be easily arranged between VITA and the new licensee.

B. Sharing with the NOAA MetSats

The Commission proposes that a new NVNG MSS system time-share the downlink NOAA MetSat bands in the 137 - 138 MHz band. Leo One USA believes that NVNG MSS systems can time-share with NOAA MetSats on a non-interference basis using a frequency avoidance concept. This simplified frequency sharing concept requires the Little LEO satellites to step or hop to the

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62 A more detailed analysis of the Commission's sharing proposal appears in Appendix E.

63 *See* Appendix D for discussion of elevation angle protection.

opposite NOAA MetSat band segment whenever a NOAA MetSat satellite coverage footprint overlaps that of a Little LEO satellite horizon. The coincidence times are readily precomputed and frequency selection instructions can be loaded into each satellite to span the duration of element set validity. Time-sharing is relatively minor for a constellation like the one proposed by Leo One USA. The calculation of interference zones as the satellites move in their orbits is straight forward and easily accommodated with simple computational algorithms. Likewise, the available conflict free frequencies in each Leo One USA coverage footprint is easily updated as a function of time. This table of frequencies can be uploaded and stored for a seven day period. The memory and command overhead requirements are not significant compared to the normal projected traffic load.

Based on Leo One USA's analysis, the NOAA TIP channels can be time-shared until the NOAA satellites all become inoperable around 2002, after the second LRPT channel satellite is launched.[64] NOAA LRPT bands can be used exclusively until the launch of the European METOP satellite and/or NOAA satellites designed to operate in the bands. Even after these satellites are launched, it may be possible for NVNG MSS satellites to time-share the LRPT bands with MetSats. At the present time, however, it is not clear how many satellites will use the LRPT bands. The Russians, Europeans and NOAA have all identified these bands for MetSat programs. Since the total number of satellites using the LRPT band is uncertain, a Little LEO system cannot rely on being able to continue to use the LRPT band beyond about 2007. Given the above situation, the NVNG MSS system can only rely on the NOAA TIP channels for long-term use.[65] Nevertheless, operation of a

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64 NVNG MSS could use these channels on a co-primary basis beginning on January 1, 2000. *See* U.S. Frequency Allocation Table at US 318.

65 A detailed analysis of time-sharing in this band appears in Appendix E.

NVNG MSS system with high availability is feasible using this spectrum. The following is a review of the issues presented by use of this band by new NVNG MSS licensees.

1. Orbcomm Cannot be Provided Access to Additional Channels in the 137 - 138 MHz Band

The Notice indicates that NOAA and Orbcomm have been coordinating Orbcomm's use of the 137 - 138 MHz band. Evidently the FCC appears to have agreed that Orbcomm may migrate some of its operations from the 137.1850 - 137.2375 sub-bands to as many as two of the NOAA channels, specifically the 137.485 - 137.515 MHz and 137.605 - 137.635 MHz channels. Leo One USA objects to this arrangement.

As the Commission is aware, Leo One USA, FACS, CTA, E-SAT and VITA have all requested in their pending applications use of the specific channels that the Commission is now planning to assign to Orbcomm. Moreover, Orbcomm has requested six additional channels in the 137 - 138 MHz band in its own pending second round application. The proposed arrangement between Orbcomm and NOAA raises a number of very troubling issues. First, these channels are central to the resolution of the second NVNG MSS processing round. For the FCC to summarily assign these channels to Orbcomm without notice and comment presents significant procedural and policy issues. Before the Commission assigns these channels, it should first establish a record. It must then review the record to determine whether the public would be better served if these channels were made available to Orbcomm or another NVNG MSS operator. This will require an analysis of the technical and corresponding economic impact on Orbcomm of maintaining the existing

channel assignment scheme and the competitive implications of assigning the channels to another licensee.[66]

Second, the pending NVNG MSS applicants have submitted mutually exclusive requests to use spectrum in the 137 - 138 MHz band. The Commission cannot ignore these procedurally valid requests to use the spectrum and act to cut off the rights of the applicants to the spectrum without providing these parties a hearing.[67] Commission assignment of these channels to Orbcomm would be particularly disturbing in this case because the rights of the parties with mutually exclusive requests to use the spectrum would be cut off to benefit a party which has not submitted a public request to use the spectrum.

2. NOAA Must Provide Accurate Ephemeris Data

The ability of the Little LEOs to avoid NOAA satellite coverage areas will depend on obtaining accurate ephemeris data or element sets from NOAA. It would seem most appropriate for NOAA to provide this data, along with the frequencies in use on each satellite, to any Little LEO system using the same spectrum. As the orbital ephemeris are presumably stable and well defined, weekly updates should provide sufficient accuracy. Orbit propagators are available that are more

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66 It is possible that Orbcomm could maintain its existing channel assignment scheme and still protect NOAA with minimum economic and technical dislocations. For instance, Orbcomm could incorporate filters into its satellite design as a means to protect NOAA operations. The cost of these filters could be negligible. At the same time, these two channels could facilitate the introduction of new services or additional competition in existing markets by a second round system, thus enhancing the consumer surplus.

67 *Ashbacker Radio Corp. v. FCC*, 326 U.S. 327 (1945).

than adequate to project orbital ephemeris forward 7 to 10 days with sufficient accuracy to preclude interference to the NOAA users.

Leo One USA's preferred means of transferring ephemeris data is electronic transfer. NOAA uses NORAD mean two line element sets for orbit prediction. Leo One USA would prefer an orbit state vector that is of higher precision to reduce the uncertainty of the coverage zone. Leo One USA recommends that an electronic copy of the data be transferred via the Internet as well as a direct modem-to-modem backup link via telephone. Since the amount of data to be transferred is small, voice transfer is also feasible as a backup should the first two means fail. In order to ensure against natural disasters, primary and backup/redundant COCC and NOCC centers will also receive the data. In the event all telephone links to the primary COCC site are inoperable, the NOCC will assume the COCC function. For this reason Leo One USA would recommend the element set data be simultaneously delivered to the NOCC and COCC. In order to ensure only valid data is used in this transfer, and to prevent "spoofing," a Digital Signature Algorithm will be used to verify message authenticity and to detect any file tampering. If further protection is warranted, a National Institute of Standards and Technology (NIST) approved encryption algorithm could be used to encode the data prior to FTP transfer over the Internet. Leo One USA assumes the government will provide a corresponding point of contact should obvious errors be detected in the data sets transferred and to respond to any other urgent matters.

3. Point of Contact

The proposed requirement for Little LEO operators to identify a point of contact accessible twenty-four hours a day so that anomalies or reports of interference while time-sharing can be addressed expeditiously does not impose any significant impact on currently planned operations.

Leo One USA intends to operate its COCC and the NOCC 24 hours a day for normal network and constellation maintenance reasons. Some gateways, however, may not be manned at all times. Nonetheless, during these periods those gateways designated as alternate command injection sites will have the means to remotely receive command uploads for specific satellites and automatically transfer these commands upon satellite contact. Leo One USA plans to have key engineering personnel required to resolve anomalous events on-call at all times at the COCC and NOCC.

4. 48 Hour Reset Signal is Unnecessary

The need for a 48 hour reset signal is arbitrary and unnecessary. Leo One USA assumes this requirement is intended to ensure that the satellites are functioning properly. At present, Leo One USA is not planning to provide for every gateway to have the ability to command the satellites. While Leo One USA plans to communicate with the satellites in its constellation at least once every three days, consistent with its orbit repeat cycle, the ephemeris data necessary to ensure operation outside NOAA exclusion zones will be valid for at least seven days. Thus, there is no need to communicate with every satellite every 48 hours. Leo One USA would prefer that if a satellite had not heard from its command center within seven days in order to receive a new set of ephemeris exclusion zone data, that it would then cease transmissions until such time that a valid upload is received. The probability of a satellite failing to cease transmissions is exceedingly small. With doubly redundant fail-safe methods and typical electronics reliability (probability of failure of less than .001 over 5 years), it is straightforward to show that the probability of the satellite becoming a rogue interferer is less than 5×10^{-8} in five years for the entire Leo One USA 48 satellite

constellation.[68] Because of the low probability of this rogue satellite interference, the imposition of a 48 hour timer reset does not seem justified.

Leo One USA proposes instead of the 48 hour reset signal that a series of dual redundant fail safe procedures be implemented to ensure the satellite does not operate in a NOAA exclusion zone. These procedures can best be determined by each Little LEO system.

5. Shut Down Requirements

Leo One USA concurs with the concept of not operating on the NOAA frequencies when within the NOAA coverage footprint. In this manner, the Little LEO service can be provided on a non-interference basis to the NOAA users. However, interference can come from many sources besides a Little LEO satellite. Before NOAA unilaterally shuts down a commercial Little LEO service, an agreed upon method of determining the source of the interference must be developed. Assuming a reasonable approach can be mutually agreed upon, Leo One USA would agree to shutting down the offending satellites. By design and ground testing, spurious emissions and potential harmonic interference sources would be eliminated in any competent development prior to launch. Thus, the most likely sources of interference become on-orbit hardware failures, on-orbit soft failures that are correctable or operational procedural failures that should also be correctable.

6. MetSat Earth Stations Operating at 137 - 138 MHz Should be Protected Only While the Associated Satellites are Located at Elevation Angles of Five Degrees or Greater

Consistent with applicable functional requirements, performance factors, and international frequency sharing criteria, meteorological earth station receivers operating at 137 - 138 MHz should

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[68] *See* Appendix E for further analysis of this issue.

be protected only while the associated satellites are located at elevation angles of five degrees or greater. There generally are no functional requirements to receive "direct readout" data[69] from meteorological satellites at elevation angles less than five degrees because the associated geographic areas are too limited and distant to indicate current and evolving meteorological conditions. Even if reception of data at lower elevation angles were desired, the received data (if any) generally would be too flawed to be of value as a result of signal degradation due to atmospheric refraction and multipath phenomena. Accordingly, a minimum elevation angle of five degrees is specified for interference and frequency sharing criteria adopted internationally for meteorological-satellite earth stations.[70]

7. MetSat Earth Stations Will Not Experience Adverse Effects From NVNG MSS Transmissions

The NOAA satellite transmission formats and rates are sufficiently different from those of the proposed Little LEOs that NOAA receivers should not respond to the Little LEO signals. Likewise, Little LEO receivers will not respond to NOAA transmissions due to the different modulation formats and data rates. While a Leo One USA receiver may attempt acquisition of a NOAA signal carrier, the Little LEO receiver will not respond due to the lack of a CRC check sum

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69 "Direct readout" consists of the data that are collected by sensors on the satellite and transmitted in real-time.

70 A detailed analysis of this issue appears as Appendix D. Appendix E discusses the effects on commercial operation of an NVNG MSS system if required to operate with NOAA protection down to 0 degrees.

validation, even if data rates were the same, just as it will not respond to noise signals. In this manner, its operation is transparent to the user.[71]

C. Sharing with DMSP

The Notice proposed that System 3 share the downlink DOD DMSP bands at 400.150-400.505 and 400.645-401.0 MHz under the assumption that the DOD system will eventually be composed of a five satellite system. Leo One USA agrees with the Commission's assessment and endorses its action in presenting this revolutionary spectrum sharing arrangement.[72] The DMSP MetSat band can be shared on a non-interference basis with DMSP using a frequency avoidance concept. This simplified frequency sharing concept requires the Little LEO satellites to step or hop to the opposite DMSP MetSat band segment whenever a MetSat coverage footprint overlaps that of a Little LEO satellite horizon. The coincidence times are readily precomputed and frequency selection instructions can be loaded into each satellite to span the duration of element set validity.[73]

1. DMSP Does Not Need Protection Below a 5° Elevation Angle

Protection of DOD MetSats at 0° is beyond any operational requirements and capabilities of the DMSP satellites and their ground terminals. Additionally, the imposition of a 0° elevation angle protection would significantly impact the capabilities of a Little LEO system. Consistent with

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71 *See* Appendix E for a detailed discussion of this issue.

72 While the implications are not yet clear, it should also be noted that Germany submitted an Advanced Publication to the ITU on September 27, 1996 for the SAFIR-II network of LEO satellites with uplinks in the 399.9 - 400.05 MHz and downlinks in the 400.6 - 400.9 MHz band. How SAFIR intends to share worldwide with the DMSP MetSats is not clear and could complicate any proposed sharing arrangements. Leo One USA believes adequate service can be provided through this band sharing arrangement. It does not believe there is room for an additional system in this band beyond that proposed for System 3 in this spectrum.

73 A detailed analysis of DMSP and NVNG MSS sharing appears in Appendix E.

applicable functional requirements, performance factors, and international frequency sharing criteria, meteorological earth station receivers operating at 400.15 - 401 MHz should be protected only while the satellites are at elevation angles of 5 degrees or above. There generally are no functional requirements to receive "direct readout" data[74] from meteorological satellites at elevation angles less than five degrees because the associated geographic areas are too limited and distant to indicate current and evolving meteorological conditions. Even if reception of data at lower elevation angles were desired, DMSP transmissions cannot be reliably received below a 5° elevation due to multipath and local interference just as a Little LEO's transmissions would not be reliably received. Accordingly, a minimum elevation angle of five degrees has been specified for interference and frequency sharing criteria adopted internationally for meteorological-satellite earth stations.[75]

2. NVNG MSS System Testing Requirements

The requirement for testing the NVNG MSS system's ability to change downlink frequency within 90 minutes in the DMSP bands up to four times a year seems excessive, arbitrary and an unnecessary imposition on the operation of a commercial communications system. Once a year would seem more than adequate to demonstrate an NVNG MSS system's capabilities. Any system operating in the DMSP bands will continually be required to change frequencies as satellites approach the radio horizon of a DMSP satellite. This requirement is a natural result of the DMSP

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74 "Direct readout" data consists of the data that are collected by sensors on the satellite and transmitted in real-time.

75 A detailed analysis of this issue appears as Appendix D. Appendix E discusses the effects on commercial operation of an NVNG MSS system if required to operate with DMSP protection down to 0 degrees.

operation since each DMSP band individually does not support the entire spectrum requirements of a NVNG MSS system's downlinks. Thus, as the horizon of a NVNG MSS satellite approaches the DMSP footprint operating in the same band, the NVNG MSS satellite must change to the opposite frequency band. In so doing, it must temporarily select a frequency that is not in use with any other NVNG MSS satellite that also overlaps its radio horizon. At times there could be up to nine other NVNG MSS satellites in contact with any given satellite's horizon coverage footprint. This will not be a problem for Leo One USA under normal circumstances since different frequencies are assigned to each orbit plane. Ordinarily any required frequency changes are planned well in advance so the entire constellation frequency plan will change at the same time using stored commands.

Given the above, Leo One USA encourages the Commission to require at most an annual test during those years when an operational change has not occurred, and preferably not during peak traffic periods over principal market areas.

3. 90 Minute Command Station Requirements

Leo One USA believes the 90 minute command station requirement proposed by the Commission is excessive and unnecessary. While it is theoretically possible to command an entire satellite constellation in 90 minutes, a worldwide network of command stations is required. Leo One USA does not intend to locate command stations outside the U.S. In particular, it does not intend each gateway to have a satellite command capability. It believes a network of command stations operated within CONUS can provide a response time of less than 11 to 14 hours for orbit inclinations of approximately 50 degrees. A network of command stations operated from U.S. soil

can reduce this to under 8 hours. Additional command stations in foreign locations would be necessary to reduce this to meet a 90 minute command time. In general, it is very difficult to command a constellation in less than its orbital period. For Leo One USA, the orbital period is approximately 104 minutes.

The operational motivation for unscheduled frequency changes is not clear, except in response to an abrupt onset of local interference in some geographic area. Overlapping DMSP footprint coverage can be predicted long in advance and frequency changes regularly scheduled and coordinated with an NVNG satellite Constellation Operations Control Center (COCC). If intentional jamming were the motivation for changing frequencies, the proposed frequency change would be totally ineffective. A jammer could quite easily monitor the bands for the downlink and instantaneously jam the channel or, alternatively, it could jam both channels simultaneously as satellites enter its horizon.

Nonetheless, if it is determined that an accelerated frequency plan update is a DMSP requirement, Leo One USA has determined that it is feasible to attain a 120 minute response time using a limited number of foreign command stations. Given no warning, and with automated command generation software, it is estimated that it may take 10 to 15 minutes for the command streams to be generated and transmitted to the appropriate remote command stations. This assumes the only inputs required in real-time are the new frequency bands in use by up to five DMSP satellites. Thus, realistically, this leaves not 90 minutes to recommand the satellite network, but 75 to 80 minutes to meet the DOD requirement. Leo One USA suggests that a "one orbital period"